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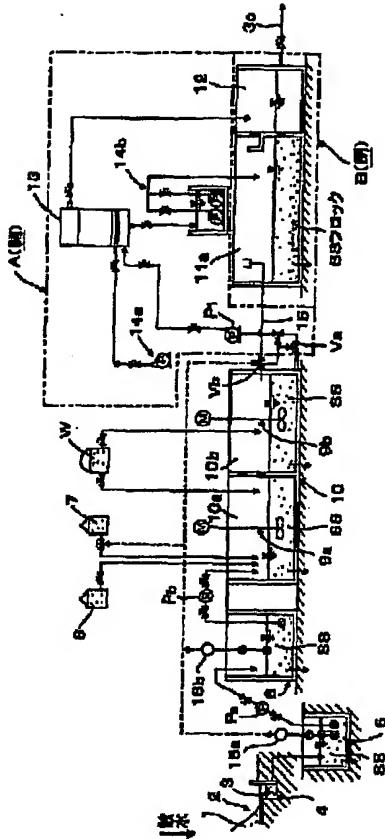
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METHOD FOR REMOVING
SUSPENDED SOLID(SS)



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(54) {Title of the Invention} Method for the elimination of suspended solids from yard drainage water

(57) {Summary}

{Problem} To provide a method for the elimination of suspended solids (SS) from yard drainage water which, in a drainage water treatment method that eliminates SS from yard drainage water, greatly reduces the drainage treatment costs by reducing the equipment costs and by greatly reducing the flocculant costs.

{Means of resolution} In a method for the elimination of suspended solids (SS) from yard drainage water that contains SS that uses both a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation, yard drainage water that contains a high concentration of SS and a small quantity of water by sprinkling when the weather is clear, and yard drainage water that contains a low concentration of SS and a large quantity of water when a standard rainfall quantity has been exceeded are treated in series by switching or arranging in series, depending on the quantity of drainage water, the aforementioned small water quantity / high SS concentration drainage water treatment process and large water quantity / low SS concentration drainage water treatment process.

{Scope of the Patent Claims}

{Claim 1} A method for the elimination of suspended solids (SS) from yard drainage water characterized in that, being a process for the treatment of yard drainage water that contains SS in which a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation are switched, yard drainage water that contains a high concentration of SS and a small quantity of water by sprinkling when the weather is clear is treated by the aforementioned small water quantity / high SS concentration drainage water SS treatment process, and yard drainage water that contains a low concentration of SS and a large quantity of water when a standard rainfall quantity has been exceeded is treated by the aforementioned large water quantity / low SS concentration drainage water treatment process.

{Claim 2} A method for the elimination of suspended solids (SS) from yard drainage water that uses both a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation, a yard drainage water SS elimination treatment method characterized in that

drainage water that contains a high concentration of SS and a small quantity of water when the weather is clear is treated by a small water quantity / high SS concentration drainage water treatment process, and when it is raining, the large water quantity / low SS concentration drainage water is made to overflow (or bypass) into the large water quantity / low SS concentration drainage water treatment process, and both a small water quantity / high SS concentration drainage water treatment process and a large water quantity / low SS concentration drainage water treatment process are used.

{Claim 3} A method for the elimination of suspended solids (SS) from yard drainage water as stated in claim 1 or 2, characterized in that the period of switching of the small water quantity / high SS concentration drainage water treatment process and the large water quantity / low SS concentration drainage water treatment process is determined by rainfall quantity information.

{Claim 4} A method for the elimination of suspended solids (SS) from yard drainage water as stated in claim 1 or 2, characterized in that the period of switching of the small water quantity / high SS concentration drainage water treatment process and the large water quantity / low SS concentration drainage water treatment process is determined by the water level in the source water tank or in the adjustment tank of the stage before these drainage water treatment processes.

{Claim 5} A method for the elimination of suspended solids (SS) from yard drainage water that uses both a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation, a yard drainage water SS elimination treatment method characterized in that the small water quantity / high SS concentration drainage water process when it is raining is arranged in series in the stage before the large water quantity / low SS concentration drainage water treatment process, and the drainage water that contains a high concentration of SS and a small quantity of water and the drainage water that contains a low concentration of SS and a large quantity of water are first treated by the small water quantity / high SS concentration drainage water treatment process, and then treated by the large water quantity / low SS concentration drainage water treatment process.

{Claim 6} A method for the elimination of suspended solids (SS) from yard drainage water that uses both a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS

concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation, a yard drainage water SS elimination treatment method characterized in that the large water quantity / low SS concentration drainage water treatment process is arranged in series in the stage before the small water quantity / high SS concentration drainage water process when the weather is clear, and drainage water that contains a high concentration of SS and a small quantity of water and drainage water that contains a low concentration of SS and a large quantity of water are first treated by the large water quantity / low SS concentration drainage water treatment process, and then treated by the small water quantity / high SS concentration drainage water treatment process.

{Claim 7} A method for the elimination of suspended solids (SS) from yard drainage water as stated in any of claims 1 to 6, characterized in that the backwash water of the filtration device of the small water quantity / high SS concentration drainage water treatment process is introduced into the large water quantity / low SS concentration drainage water treatment process.

{Detailed Explanation of the Invention}

{0001}

{Industrial field of use} This invention pertains to a method for the elimination of suspended solids (SS) from yard drainage water that occurs due to sprinkling or rain in outdoor yards where dust particles (including lumps; referred to below as "dust particles") are stored.

{0002}

{Prior art} Broadly divided, drainage water in the steel manufacturing industry is classified into:

- (1) Factory drainage water such as cooling drainage water and rinsing drainage water generated by cooling and rinsing that accompany factory mass production activities;
- (2) Rain drainage water generated by falling rain.

{0003} In the prior art, pollution prevention measures against (1) factory drainage water were devised but recently measures when it rains have been devised due to a heightened consciousness about pollution. Although the degree varies depending on local conditions, places where pollution problems occur due to rain, and their pollution countermeasures (substances), include the following.



1. Raw materials, secondary raw materials, coal yards ... SS (suspended solids), color, pH
2. Scrub yards ... SS, color, oil
3. Storage yards ... SS, pH

{0004} Among these outdoor yard drainage water treatment processes, as a drainage water treatment process to eliminate SS used in the prior art, as shown in Figure 6, for example, there was a process in which yard drainage water 3 that contains a large quantity of SS from a storage yard 2 of iron ore 2 is collected in a pump pit 5 via a U-shaped gutter 4, and it is collected in an adjustment tank 6 by a pump Pa from the pump pit 5, and after the quantity of water is adjusted, it is introduced into a sedimentation pool via a flocculation reaction tank 10 with a stirrer 9 to which a flocculant 7 or treatment agent 8 was added, and the SS that was made to flocculate in the flocculation reaction tank 10 is made to settle out and is eliminated, and the supernatant 3c that has been rendered harmless is released into a river or ocean via a water tank 12. This drainage water treatment process of the prior art can be used both when it is raining or when the weather is clear, and the equipment cost is high because a large flocculation reaction tank 10 and sedimentation pool 11 are arranged so that the volume of the estimated maximum rainfall quantity can be treated.

{0005} In recent years, from the viewpoint of preventing scattering of dust from the yard 2, sprinkled water is increased when the weather is clear, such that the drainage water 3 that contains SS and a small quantity of water is not eradicated, and drainage water treatment is performed every day. In the treatment of this drainage water, flocculant 7 is added to the flocculation reaction tank 10 that has a capacity that corresponds to the quantity of drainage water when it is raining, and the SS in the drainage water 4 is made to settle out, and the supernatant 3c is released. When the quantity of flocculant 7 added to the flocculation reaction tank 10 is small, the SS flocs are small, and the SS flocs flow out and the water quality control is affected even if the flow rate from the sedimentation pool 11 is reduced. Therefore, the amount of flocculant 7 that is added is often determined based on when the weather is clear when the change in concentration of SS is constricted.

{0006} However, the concentration of SS can vary greatly even when the weather is clear. In particular, due to the SS that remains in the gutter, the concentration of SS is high during initial drainage and gradually becomes stable. Also, when it rains, the quantity of drainage water

becomes 2 to 10 times higher than when the weather is clear, and the concentration of SS in the drainage water 3 becomes smaller the larger the rainfall quantity.

{0007} In this way, in the prior art there were the problems that, regardless of whether the concentration of SS in the drainage water changed greatly, the amount of flocculant 7 that was added was based on the conditions when the weather was clear when the concentration of SS is high, and the amount of relatively expensive flocculant that was consumed was high, and the drainage water treatment costs were high.

{0008}

{Problems the invention is to resolve} In methods for the elimination of suspended solids (SS) from yard drainage water, this invention offers a drainage water treatment method that greatly reduces the drainage treatment costs by reducing the equipment costs and by greatly reducing the flocculant costs.

{0009}

{Means for resolving the problems} This invention is constructed from inventions (1) to (7) below.

(1) A method for the elimination of suspended solids (SS) from yard drainage water characterized in that, being a process for the treatment of yard drainage water that contains SS in which a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation are switched, the yard drainage water that contains a high concentration of SS and a small quantity of water by sprinkling when the weather is clear is treated by the aforementioned small water quantity / high SS concentration drainage water SS treatment process, and the yard drainage water that contains a low concentration of SS and a large quantity of water when a standard rainfall quantity has been exceeded is treated by the aforementioned large water quantity / low SS concentration drainage water treatment process.

(2) A method for the elimination of suspended solids (SS) from yard drainage water that uses both a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation,

a yard drainage water SS elimination treatment method characterized in that the drainage water that contains a high concentration of SS and a small quantity of water when the weather is clear is treated by a small water quantity / high SS concentration drainage water treatment process, and when it is raining, the large water quantity / low SS concentration drainage water is made to overflow (or bypass) into the large water quantity / low SS concentration drainage water treatment process, and both a small water quantity / high SS concentration drainage water treatment process and a large water quantity / low SS concentration drainage water treatment process are used.

(3) A method for the elimination of suspended solids (SS) from yard drainage water as stated in (1) or (2) above, characterized in that the period of switching of the small water quantity / high SS concentration drainage water treatment process and the large water quantity / low SS concentration drainage water treatment process is determined by rainfall quantity information.

(4) A method for the elimination of suspended solids (SS) from yard drainage water as stated in (1) or (2) above, characterized in that the period of switching of the small water quantity / high SS concentration drainage water treatment process and the large water quantity / low SS concentration drainage water treatment process is determined by the water level in the source water tank or in the adjustment tank of the stage before these drainage water treatment processes.

(5) A method for the elimination of suspended solids (SS) from yard drainage water that uses both a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation, a yard drainage water SS elimination treatment method characterized in that the small water quantity / high SS concentration drainage water process when it is raining is arranged in series in the stage before the large water quantity / low SS concentration drainage water treatment process, and the drainage water that contains a high concentration of SS and a small quantity of water and the drainage water that contains a low concentration of SS and a large quantity of water are first treated by the small water quantity / high SS concentration drainage water treatment process, and then treated by the large water quantity / low SS concentration drainage water treatment process.

(6) A method for the elimination of suspended solids (SS) from yard drainage water that uses both a small water quantity / high SS concentration drainage water treatment process comprised

by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process when it is raining comprised by flocculation and sedimentation, a yard drainage water SS elimination treatment method characterized in that the large water quantity / low SS concentration drainage water treatment process is arranged in series in the stage before the small water quantity / high SS concentration drainage water process when the weather is clear, and the drainage water that contains a high concentration of SS and a small quantity of water and drainage water that contains a low concentration of SS and a large quantity of water are first treated by the large water quantity / low SS concentration drainage water treatment process, and then treated by the small water quantity / high SS concentration drainage water treatment process.

(7) A method for the elimination of suspended solids (SS) from yard drainage water as stated in any of points (1) to (6) above, characterized in that the backwash water of the filtration device of the small water quantity / high SS concentration drainage water treatment process is introduced into the large water quantity / low SS concentration drainage water treatment process.

{0010}

{Implementation configurations of the invention} This invention is an SS elimination treatment method for drainage water from outdoor yards that store primarily dust particles, that uses a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large quantity / low SS concentration drainage water treatment process comprised by flocculation and sedimentation. Basically, in drainage water treatment when the weather is clear when the SS concentration is high and the water quantity is small (here, this means when it is not raining, or when the rainfall quantity is small and the dust particles are dry and scatter; referred to below as "when the weather is clear"), the small water quantity / high SS concentration drainage water treatment process is used, and when it is raining and the SS concentration is low and the water quantity is large, the large water quantity / low SS concentration drainage water treatment process is used.

{0011} In this invention, because a flocculation and filtration process is used in the small water quantity / high SS concentration drainage water treatment process, even if the amount of flocculant that counterbalances that SS concentration is not satisfactory for drainage water of relatively high SS concentration of more than 500 mg/liter when the SS concentration is high

when the weather is clear, the SS is easily adsorbed and captured in the SS flocs captured in the filter material, and SS elimination is performed with certainty. Therefore, the amount of flocculant that is used can be reduced by 50% compared to the prior art.

{0012} As the filtration device of the flocculation and filtration process used in this invention, various types of known filtration devices that use natural sand or floating filter materials as the filter material can be used, but to assure stable filtration functionality, it is beneficial to have a structure in which the filter material is backwashed by gas or liquid.

{0013} Also, since the drainage water when it rains has a large quantity of water and the SS concentration is relatively low at 300 mg/liter, the amount of flocculant that is used can be smaller than in the small water quantity / high SS concentration drainage water treatment process, and the amount of flocculant that is used can be set differently from that of the small water quantity / high SS concentration drainage water treatment process, and it can be 50% less than in the prior art.

{0014} As the flocculant used in this invention, organic high-molecular flocculants are often used, and in addition, inorganic flocculants such as polyaluminum chloride (PAC) or anionic or cationic surface active agents can be used. As the filter material, natural sand is generally used, but the filter material is not limited to natural sand.

{0015} Here, if a flocculation and sedimentation process is used instead of a filtration or flocculation and filtration process for the drainage water that contains a high concentration of SS and a small quantity of water, the produced SS flocs are fine and light with small bonding strength, and therefore it outflows easily from the sedimentation pool, and since it is hard to reliably perform SS elimination, a large quantity of flocculant is required to eliminate the high-concentration SS, the treatment cost is high, which is undesirable.

{0016} Also, in this invention, since a flocculation and sedimentation process is used in the large water quality / low SS concentration drainage water treatment process, a sedimentation pool of a capacity that corresponds to the object flow rate is required, but there are advantages of scale from the viewpoint of civil engineering construction, and there is the advantage that the equipment costs are not increased in proportion to the increase in capacity, and it is also easy to increase the scale. Also, the SS is made to flocculate and settle out in the sedimentation pool, but since the SS concentration is low, the SS can be easily made to flocculate and settle out and

can be easily eliminated, even though the amount of flocculant used is smaller than in the prior art. As the sedimentation pool used in flocculation and sedimentation in this invention, various types of known sedimentation pools such as horizontal sedimentation pools and circular sedimentation pools can be used.

{0017} In this invention, basically, the large water quantity / low SS concentration drainage water treatment process and the small water quantity / high SS concentration drainage water treatment process are switched depending on the quantity of drainage water from the yard (sprinkling quantity when the weather is clear, rainfall quantity when it is raining), but treatment is apportioned by arranging both a small water quantity / high SS concentration drainage water treatment process and a large water quantity / low SS concentration drainage water treatment process in series, and they can be alternately used as a backup.

{0018} Also, in the small water quantity / high SS concentration drainage water treatment process by flocculation and filtration, the filtration device is made to flow back, but the backwash water that contains SS after this backwash is introduced into the large water quantity / low SS concentration drainage treatment process, and this backwash water is treated together with the large water quantity / low SS concentration drainage water, and therefore the equipment cost and treatment cost are reduced.

{0019} In the present invention, switching of the small water quantity / high SS concentration drainage water treatment process comprised by flocculation and filtration and the large water quantity / low SS concentration drainage water treatment process comprised by flocculation and sedimentation is performed manually or automatically when the quantity of drainage water (t/hr) from the yard satisfies the switching conditions (when sprinkling drainage water level pertains, quantity judgment standards of whether the drainage water level exceeds standard rainfall quantity; judgment standards are set in advance). As means for judging this quantity of drainage water,

- (1) It is judged subjectively.
- (2) The quantity of drainage water from the yard is estimated by the sprinkling water quantity when the weather is clear.
- (3) The quantity of drainage water from the yard is estimated by the rainfall information (rainfall forecast of the relevant region or actual rainfall quantity information of the relevant region).

(4) The quantity of drainage water from the yard is estimated by detecting the water level of the adjustment tank or the source water tank of the stage before the drainage water treatment process.

In (2) to (4) above, by linking the drainage water quantity estimation system and the switching system it is also possible to automatically switch the small water quantity / high SS concentration drainage water treatment process and the large water quantity / low SS concentration drainage water treatment process comprised by flocculation and sedimentation.

{0020} In the present invention, the object of treatment is yard drainage water that contains a large quantity of SS, but there are also cases where color, pH, oil, COD (chemical oxygen demand) are used. In these cases, there is an additional process that includes the addition of a reaction treatment agent such as NaOH in addition to the flocculant in the sedimentation reaction tank, but there is no problem in applying this invention to such cases as well.

{0021}

{Implementation examples} This invention is explained below together with examples of equipment layout:

{Implementation example 1} Figure 1 shows an example of the arrangement of the drainage water treatment equipment of an iron ore storage yard in which this invention is implemented. Figure 1 shows the case where drainage water that contains a high concentration of SS and a small quantity of water when the weather is clear is treated. Figure 2 shows the case where drainage water that contains a low concentration of SS and a large quantity of water when it is raining is treated.

{0022} In figures 1 and 2, 1 is iron ore stored in the yard 2; 3 is yard drainage water that contains SS produced by sprinkling, which is collected in a source water tank 5 via a U-shaped gutter 4. By means of a pump Pa, the drainage water is introduced via an adjustment tank 6 in which a flocculant 7 and a treatment agent 8 are added, into a flocculation reaction tank 10 comprised of a reaction tank 10a that performs stirring treatment by a stirrer 9a, and a flocculation tank 10b that performs stirring treatment by a stirrer 9b and grows the SS flocs.

{0023} In this implementation example, as the drainage water treatment process after the reaction and flocculation treatments, two processes are arranged in series. First, there is the small water quantity / high SS concentration drainage water treatment process A, consisting of a

filtration device 13 that has a backwash structure that uses air and filter material to filter the drainage water that contains the SS flocs grown from the flocculation reaction tank 10, and backwash devices 14a (supply side) and 14b (drainage side) that maintain the filtration function by back washing this filtration device with backwash water. Second, there is the large water quantity / low SS concentration drainage water treatment process B, consisting of a sedimentation pool 11a, which is connected to the flocculation reaction tank 10 by a connection pipe 15a, in which drainage water that contains SS flocs produced from the flocculation reaction tank 10 undergoes sedimentation treatment, and the SS flocs are made to settle out and are removed.

{0024} Basically, the small water quantity / high SS concentration drainage water treatment process A is for treating drainage water that contains a high concentration of SS and a small quantity of water, and the large water quantity / low SS concentration drainage water treatment process B is for treating drainage water that contains a low concentration of SS and a large quantity of water in the case where the rainfall quantity exceeds a standard rainfall quantity. Here, the drainage water treatment processes can be switched manually or automatically in the following three ways.

- (1) Only small water quantity / high SS concentration drainage water treatment process A when clear (when the weather is clear)
- (2) Only large water quantity / low SS concentration drainage water treatment process B when raining (when it is raining)
- (3) Both small water quantity / high SS concentration drainage water treatment process A when the weather is clear and large water quantity / low SS concentration drainage water treatment process B when raining (when it is raining)

{0025} The drainage water treatments of (1) to (3) are explained below.

As shown in figure 1 "Drainage water treatment by small water quantity / high SS concentration drainage water treatment process A when the weather is clear according to (1)," yard drainage water 3 that contains SS produced by sprinkling is collected in the source water tank 5 via a U-shaped gutter 4, and by pump Pa it is introduced into the adjustment tank 6, and by pump Pb a flocculant 7 and a treatment agent 8 are added, and the drainage water is introduced into a flocculation reaction tank 10 comprised of a reaction tank 10a that performs stirring treatment by a stirrer 9a, and a flocculation tank 10b that performs stirring treatment by a stirrer 9b and grows

the SS flocs. Here, since the drainage water that is treated is drainage water in which the SS concentration is high, the amount of added flocculant 7 is increased in order to grow SS flocs more reliably. The switch valve Va is opened, and the drainage water 3 that has undergone the reaction flocculation process and contains grown SS flocs is introduced by pump P1 into a filtration device 13 of the small water quantity / high SS concentration drainage water treatment process A when the weather is clear. Here it is filtered, and the filtered drainage water 3 is released via the water tank 12.

{0026} In the filtration device 13, the quantity of sediment is accumulated, and when this quantity of sediment exceeds a certain fixed level, the filtration resistance becomes large and filtration functioning is reduced, and the quantity of sediment leads out and the filtration water quality becomes worse. Therefore, the filtration device 13 is backwashed by air and backwash water from the backwash device 14a, and reduction of filtration functioning is prevented. The backwash water that contains sediment after washing is introduced into the sedimentation pool 11a where it undergoes sedimentation treatment, but it can also be drained out to a site other than the sedimentation pool 11a.

{0027} In this drainage water treatment process (1), the flocculation efficiency is good and filtration and sedimentation use a small quantity of flocculant, and since the amount of flocculant 7 that is used can be greatly reduced compared to the case where only sedimentation and flocculation are performed, it is suitable for treatment of small water quantity / high SS concentration drainage water when the weather is clear.

{0028} As shown in figure 2 "Drainage water treatment by the large water quantity / low SS concentration drainage water treatment process B when it is raining according to (1)," yard drainage water 3 that contains SS produced by the rain is collected in the source water tank 5 via a U-shaped gutter 4, and by pump Pa the drainage water is introduced into the adjustment tank 6, and by pump Pb a flocculant 7 and a treatment agent 8 are added, and it is introduced into a flocculation reaction tank 10 comprised of a reaction tank 10a that performs stirring treatment by a stirrer 9a, and a flocculation tank 10b that performs stirring treatment by a stirrer 9b and grows the SS flocs. Here, since the drainage water that is treated is drainage water in which the SS concentration is low, the amount of added flocculant 7 added in order to grow the SS flocs is reduced.

{0029} When it is raining, the water levels of the source water tank 5, the adjustment tank 6 and the reaction flocculation tank 10 are increased due to the rainfall. Therefore the water level is detected by a water meter 16a of the source water tank 5, for example. If this water level is above the fixed level, the switching valve Va is closed, and the small water quantity / high SS concentration drainage water process A when the weather is clear is stopped, and the switching valve Vb is opened, and the SS drainage water that contains SS flocs grown from the reaction flocculation tank 10 is introduced into the sedimentation pool 11a via the connection pipe 15.

{0030} When the rain stops and the quantity of drainage water is reduced to a drainage water quantity level of clear weather, the switching valve Va is opened, and the small water quantity / high SS concentration drainage water treatment process A when the weather is clear is started. The amount of flocculant 7 that is added to the reaction flocculation tank 10 does not have to be immediately increased, but can be increased when the weather becomes clear and the iron ore becomes dry and sprinkling becomes necessary.

{0031} In this drainage water treatment process (2), the flocculation and sedimentation process is performed using the sedimentation pool 11a, but since the yard drainage water treatment when it is raining when the concentration of SS is low is distinguished from the yard drainage water treatment when the weather is clear when the concentration of SS is high, the amount of flocculant used can be reduced even if the amount of flocculant used is small, and the amount of flocculant used is smaller than the case of the prior art in which the yard drainage water treatment process when the weather is clear when the concentration of SS is high and the yard drainage water treatment process when it is raining when the concentration of SS is low are performed in the same way.

{0032} In the drainage water treatment process "Both the small water quantity / high SS concentration drainage water treatment process A when the weather is clear and the large water quantity / low SS concentration drainage water treatment process B when it is raining according to (3)," during the treatment of yard drainage water that contains SS produced by sprinkling by the small water quantity / high SS concentration drainage water treatment process A when the weather is clear as shown in Figure 1, in the case where there has been rainfall, the switching valve Va of this drainage water treatment process A is left open as is, and, as shown in Figure 2, the switching valve Vb of the large water quantity / low SS concentration drainage water treatment process B when it is raining is opened, and this drainage water treatment process B is

started, and both drainage water treatment process A and drainage water treatment process B are performed.

{0033} In this example, a switching valve Vb is provided and the open operation is performed in the case where the process is switched from drainage water treatment process A to drainage water treatment process B, but the switching valve Vb is not necessarily required, and it is possible to have the SS drainage water that contains SS flocs that were grown in the reaction flocculation tank 10 overflow via an overflow pipe 17 and be introduced into the sedimentation pool 11a when the water level rises.

{0034} Here, when there is rainfall and the yard drainage water increases and the water level in the reaction flocculation tank 10 of the drainage water that contains SS flocs grown in the reaction flocculation tank 10 rises, this drainage water is made to naturally overflow from the overflow pipe 17, and this overflow portion is introduced into the large water quantity / low SS concentration drainage water treatment process B when it is raining, and it undergoes the flocculation and sedimentation process in the sedimentation tank 11a. Since this yard drainage water 3 due to rainfall immediately becomes drainage water of low SS concentration, the amount of flocculant 7 added to generate SS flocs is changed to a small amount.

{0035} In this drainage water treatment process (3), the flocculation efficiency is good and both flocculation and filtration as well as flocculation and sedimentation are performed with a small amount of flocculant added, and the amount of flocculant that is used can be greatly reduced compared to the case where only flocculation and sedimentation are used.

{0036} {Implementation example 2} Figure 4 shows an example of the arrangement of drainage water treatment equipment of implementation example 2. In implementation example 2, the small water quantity / high SS concentration drainage water treatment process A when the weather is clear (referred to below as "drainage water treatment process A") is connected to the flocculation reaction tank 10, and in the final stage, the large water quantity / low SS concentration drainage water treatment process B when it is raining (referred to below as "drainage water treatment process B") is connected in series. Thus, the drainage water that contains SS flocs grown from the flocculation reaction tank 10 is first treated with drainage water treatment process A, and then it undergoes sedimentation treatment by drainage water treatment process B.

{0037} In implementation example 2, both the drainage water that contains a high concentration of SS and a small quantity of water when the weather is clear and the drainage water that contains a low concentration of SS and a large quantity of water when it is raining are treated in the same way, first by drainage water treatment process A, and then by drainage water treatment process B. In implementation example 2, when the drainage water that contains a high concentration of SS and a small quantity of water when the weather is clear is treated, in the case where the backwash interval of the flocculation and filtration process of drainage water treatment process A is long, if the SS capture limit is exceeded and SS flocs flow out from the filtration device 13, they can be reliably eliminated by the sedimentation process of drainage water treatment process B.

{0038} {Implementation example 3} Figure 5 shows an example of the arrangement of drainage water treatment equipment of implementation example 3. In implementation example 3, the drainage water treatment process B when it is raining is connected to the flocculation reaction tank 10, and after that, the drainage water treatment process A is connected in series, and after that the sedimentation pool 11a of drainage water treatment process B when it is raining is connected in series. Thus, the drainage water that contains SS flocs grown from the flocculation reaction tank 10 is first treated by the sedimentation pool 11b of the drainage water treatment process B, then it is treated by drainage water treatment process A, then it undergoes sedimentation treatment by the sedimentation pool 11a.

{0039} In implementation example 3, both the drainage water that contains a high concentration of SS and a small quantity of water when the weather is clear and the drainage water that contains a low concentration of SS and a large quantity of water when it is raining are treated in the same way, first by drainage water treatment process B, and then by drainage water treatment process A. In this implementation example, when the drainage water that contains a high concentration of SS and a small quantity of water when the weather is clear is treated, it first undergoes flocculation and sedimentation treatment by drainage water treatment process B, and after the crude SS is eliminated, the drainage water is introduced into the final drainage water treatment process A, and flocculation and filtration are performed, and the burden on drainage water treatment process A is reduced. Also, since the flocculation and sedimentation process by drainage water treatment process B precedes it, the amount of flocculant used in the

reaction flocculation tank 10 can be reduced even when the weather is clear, and the amount of flocculant 7 that is used can be greatly reduced.

{0040}

{Experimental examples} Using the equipment arrangement examples of implementation example 1 (figure 1, figure 2), SS elimination treatment of iron ore yard drainage water by sprinkling when the weather is clear and drainage water by rainfall when it is raining were performed. The experimental conditions and the evaluation of the experimental results are explained below.

{0041} {Experimental conditions}

Iron ore yard:

Yard area: 300,000 m³

Concentration of SS in the drainage water:

Sprinkled drainage water when the weather is clear: 500 mg/liter

Rainfall drainage water when it is raining: 200 mg/liter

Quantity of drainage water treated:

Sprinkled drainage water when the weather is clear: 3 m³

Rainfall drainage water when it is raining: 20 m³

Flocculant: PAC, high-molecular flocculant

Filtration device:

Treatment capacity: 3 m³/minute

Sedimentation pool (horizontal flow type):

Volume: 1000 m³

{Evaluation}

Comparison with the prior art:

Amount of flocculant used: Reduced to less than 50% of the prior art

SS concentration: 10 mg/liter. In the prior art, 20 mg/liter.

{0042} As described above, in the yard drainage water SS elimination treatment method of the present invention, as shown in figure 5 above, the amount of flocculant used can be greatly reduced and the treatment cost can be greatly reduced compared to the flocculation and

sedimentation type yard drainage water SS elimination treatment methods of the prior art. Also, by using a flocculation and filtration process, the treatment capacity can be improved without increasing the equipment costs. Furthermore, these effects can be assured in the case of the equipment arrangement examples of implementation example 2 and implementation example 3.

{0043}

{Effect of the invention} In the present invention, both a small water quantity / high SS concentration drainage water treatment process comprised by filtration or by flocculation and filtration and a large water quantity / low SS concentration drainage water treatment process comprised by flocculation and sedimentation are used, and treatment is performed by switching or in series, and the cost of flocculants can be greatly reduced, and the overall equipment cost can be reduced, and the cost of the drainage water treatment process can be greatly reduced.

{Brief Explanation of the Diagrams}

{Figure 1} Shows the state of the drainage water treatment when the weather is clear, by a cross-sectional diagram that shows an example of drainage water treatment equipment that can switch between a drainage water treatment process when the weather is clear and a drainage water treatment process when it is raining, that implements a yard drainage water treatment method of the present invention.

{Figure 2} Shows the state of the drainage water treatment when it is raining, by a cross-sectional diagram that shows an example of the drainage water treatment equipment that can switch between a drainage water treatment process when the weather is clear and a drainage water treatment process when it is raining, that implements a yard drainage water treatment method of the present invention.

{Figure 3} Cross-sectional diagram that shows another example of the drainage water treatment equipment that can switch between a drainage water treatment process when the weather is clear and a drainage water treatment process when it is raining, that implements a yard drainage water treatment method of the present invention.

{Figure 4} Cross-sectional diagram that shows another example of the drainage water treatment equipment that arranges in series a drainage water treatment process when the weather

is clear and a drainage water treatment process when it is raining, that implements a yard drainage water treatment method of the present invention.

{Figure 5} Cross-sectional diagram that shows another example of the large-quantity drainage water treatment equipment that arranges in series a drainage water treatment process when the weather is clear and a drainage water treatment process when it is raining, that implements a yard drainage water treatment method of the present invention.

{Figure 6} Cross-sectional diagram that shows an example of the drainage water treatment equipment that implements a yard drainage water treatment method of the prior art.

{Explanation of the code numbers}

- 1 Iron ore (dust particles)
- 2 Yard
- 3 SS drainage water
- 4 U-shaped gutter
- 5 Source water gutter
- 6 Adjustment tank
- 7 Flocculant
- 8 Treatment agent
- 9, 9a, 9b Stirrers
- 10 Reaction flocculation tank
 - 10a Reaction tank
 - 10b Flocculation tank
- 11, 11a, 11b Sedimentation pools
- 12 Water tank
- 13 Filtration device
- 14a, 14b Backwash devices
- 15 Connection pipe
- 16 Water meter
- 17 Overflow pipe
- Pa, Pb, P1 Pumps

{Figure 1}

[Down-arrow] Sprinkling
A (open)
B (closed)
SS flocs

{Figure 6}

[Down-arrows] Rainfall
Rainfall
Sprinkling

House
Sewer pipe

Release

SS flocs
SS flocs

{Figure 2}

[Down-arrow] Rainfall
A (closed)
B (open)
SS flocs

{Figure 3}

[Down-arrow] Rainfall
A (closed)
B (open)
SS flocs

{Figure 4}

[Down-arrows] Rainfall
Sprinkling
A (open)
B (closed)
SS flocs

{Figure 5}

[Down-arrows] Rainfall
Sprinkling
A (open)
B (open)
SS flocs